MUTUALISTIC ASSOCIATION BETWEEN ANTS AND SOME HOMOPTERA — ITS SIGNIFICANCE IN COCOA PRODUCTION*

By A. O. Adenuga

Department of Plant Science,
University of Ife, Ile-Ife (Nigeria)

During my field collections of ants in some cocoa farms on Ondo Road in Western Nigeria, I have come to observe that certain species of ants are associated with scale insects (Coccidae), mealybugs (Pseudococcidae) and aphids in a way which suggests that the association must be mutually beneficial. Although a great deal has been done by many workers to determine experimentally the nature of this association (Strickland, 1951; Nixon, 1951; Way 1954), there seems to be so much variation in the degree of the ant-Homoptera association that many questions still remain unanswered. Further, many claims by previous workers need to be substantiated, particularly as these claims in some instances are contradictory. In this paper I present an account of the ants and Homoptera that were observed in association on the cocoa farm in West Nigeria, an analysis of this association, and a discussion of the effects of the association on the cocoa crops. Although there are records of ant-Homoptera association for Ghana and some other parts of West Africa (Strickland, 1951; Leston, 1970), these are the first such records, as far as I am aware, for Nigeria.

The following is a list of Homoptera attended to varying degrees by ants:

Family Pseudococcidae
Planococcoides sp. nr. *njalensis* (?)
Phenacoccus hargreavesi (Laing)
Planococcus citri (Risso)
Ferrisia virgata (Cockerell)
Dysmicoccus brevis (Cockerell)

Family Coccidae
Gascardia sp.

Manuscript received by the editor February 20, 1975

Family Margarididae
Icerya purchasi (immature stages)

Family Diaspididae
Aspidiotus destructor (Signoret)
Aonidiella replicata (Lindinger)

Family Aphidae
Toxoptera aurantii (Boyer de Fonscolombe) (alate and apterous, all immature stages)

Family Flatidae (?)
Genera and species undetermined (all immature states)

The following genera of ants were found associated with mealybugs (Family Pseudococcidae) listed above:

Subfamily Myrmicinae
Crematogaster spp. — workers only
(subgenus *Sphaerocrema*) *C. striatula, C. luctans, C. leneri, C. boxi.*
(subgenus) *Crematogaster* group.
(subgenus) *Atopogyne* group — *Crematogaster africana.*
Pheidole spp. (*megacephala* being the most notorious).
Macromischoides, Atopomyrmex, Cataulacus, Monomorium, Meranoplus, Xiphomyrmex, Tetramorium and *Solenopsis.*

Subfamily Formicinae
Oecophylla, Acantholepsis, Polyrachis and *Camponotus.*

Subfamily Ponerinae
Platythyrea

The mealy bugs found in association with ants can be divided into two groups — those for which the association is obligatory and those for which it is facultative. *Planococcoides njalensis,* alone in the first group, is regularly attended by ants. The obligate nature of this association is not surprising; since the mealybugs have very short legs and are ovoviparous, they most probably depend on the ants for transportation from tree to tree. The other mealybugs on the above list are facultative and are only sometimes found with ants. They have longer legs and all are oviparous.

Gascardia sp. (Coccidae) is regularly attended by *Oecophylla longinoda, Crematogaster africana* and *Macromischoides aculeata.* On the other hand, the association of *Icerya purchasi* (Margarididae), *Aspidiotus destructor* and *Aonidiella replicata* (Diaspididae) with the same ants is facultative.

Table 1a.

Oecophylla and *Crematogaster* (*Cr.*) Interaction

	Oecophylla			
	Present	Absent	Total	Ratio
Cr. Present	6	211	217	1:35
Cr. Absent	243	1010	1253	1:4

Chi-squared (X^2) = 36.3 significant at $P < 0.001$

Table 1b.

Macromischoides (*Macr.*) and *Oecophylla* Interaction

	Oecophylla			
	Present	Absent	Total	Ratio
Macr. Present	9	105	114	1:12
Macr. Absent	240	1125	1365	1:4.5

Chi-squared (X^2) = 14.55 significant at $P < 0.001$

Table 1c.

Crematogaster (*Cr.*) and *Macromischoides* Interaction

	Macromischoides			
	Present	Absent	Total	Ratio
Cr. Present	2	433	435	1:216
Cr. Absent	114	1139	1253	1:10

Chi-squared (X^2) = 96 significant at $P < 0.001$

There are five forms exhibited by ant-Homoptera 'mutualism' and these have been exhaustively discussed in a review by Way (1963). 'Mutualism' is defined as "an association between ants and other insects which is mutually beneficial without necessarily implying obligate dependence or interdependence" (Way, 1963). These forms include: (i) adaptation of the Homoptera related to the association with ants; (ii) benefits derived by the Homoptera; (iii) benefits derived by the ants in form of contribution of the Homoptera to the food of the ants; (iv) specificity in the ant-Homoptera association; (v) ant-Homoptera association in relation to their natural control.

However, one aspect of this mutualistic association, which is incidental but nevertheless significant for the host plant carrying the ants and the Homoptera, is the capacity of some of the Homoptera to transmit fungal and viral diseases to the host plant.

Laboratory tests have confirmed that all the mealybugs have been found to transmit strains of virus diseases (Thresh *et al.*, 1959) but *Planococcoides njalensis* is now considered the most important vector, especially of the virulent types of swollen shoot virus (Leston, 1970). Workers of *Crematogaster* spp. and *Macromischoides* have been observed actively carrying up cocoa trees particles of soil which they use in building their nests. During the rainy season this sort of activity will no doubt help to spread fungal spores of the black pod disease (*Phytophthora palminivora*).

There is therefore some contrast in the roles played by ants in the entomological problems of cocoa crops. Predaceous ants like *Oecophylla, Crematogaster* and *Macromischoides* more or less determine the composition of the insect spectrum. An extensive survey of cocoa farms in Nigeria for these three also confirms Leston's (1970) work in Ghana that each cocoa farm carries a mosaic of these dominant species in which the three species are more or less mutually exclusive (see Tables below).

These tables show that the coincidence of *Oecophylla* and *Macromischoides* (Table 1b) is occasional, that of *Oecophylla* and *Crematogaster* (Table 1a) very rare and that of *Macromischoides* and *Crematogaster* (Table 1c) extremely rare. Leston (1970) claimed that up to fifty percent of Ghana's cocoa trees are permanently protected by *Oecophylla* from *Distantiella* (mirid) damage in some areas. There is little doubt that both *Macromischoides* and *Crematogaster* are negatively correlated with mirid (*Distantiella* and *Salbergella*) population densities (Adenuga, unpublished report). On the other side of the scale is the fact that these ants increase the damage to cocoa crops because they encourage the establishment of viral and fungal homopterous vectors by actively transporting them and to a limited extent offering them protection against their natural parasites and predators. In addition, *Macromischoides* does direct damage, although minor, to cocoa leaves by stripping them to build its nest.

A decision as to whether or not to encourage the establishment of these ants in cocoa farms will depend on whether mirid infestation is more or less important than fungal and viral diseases of cocoa in a particular locality.

Literature Cited

Leston, D.
1970. Entomology of the cocoa farm. Ann. Rev. Entomol. 15: 273-294.
Nixon, G. E. J.
1951. The association of ants with aphids and coccids. Commonwealth Inst. Entomol., London. 36 pp.
Strickland, A. H.
1950. The entomology of swollen shoot of cacao, I: the insect species involved with notes on their biology. Bull. Entomol. Res. 41: 725-748.
1951. The entomology of the swollen shoot of cacao, II: the bionomics and ecology of the species involved. Bull. Entomol. Res. 42: 65-103.
Thresh, J. M. and T. W. Tinsley.
1959. The viruses of cacao. Tech. Bull. W. African Res. Inst.: 1-32.
Way, M. J.
1954 Studies on the association of the ant, *Oecophylla longinoda* (Latr.) with the scale insect *Saissetia zanzibarensis* Williams. Bull. Entomol. Res. 45: 113-134.
1963. Mutualism between ants and honeydew producing Homoptera. Ann. Rev. Entomol. 8: 307-344.